A Discussion of Atmospheric Electric Potential Results at Kew, from selected Days during the Seven Years 1898 *to* 1904.

By C. Chree, Sc.D., LL.D., F.R.S.

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(Abstract.)

The Paper contains an analysis of the atmospheric electricity results at Kew from selected days—usually 10 a month—during the seven years 1898 to 1904.

The days were chosen as representative of fine weather conditions, all days being excluded when rain fell or negative potential was recorded. By means of regular observations with a portable electrometer, the curve readings from the Kelvin water-dropping electrograph were converted so as to give the potential gradient in the open, in volts per meter. All the data: mean monthly values, diurnal inequalities, etc., are given in absolute measure (volts per meter). This is believed to be the first occasion on which this has been done. The diurnal inequalities for individual months and for the whole year are represented by curves. These are mostly exceedingly smooth, thus showing that a sufficient number of years' data have been included to give satisfactory results. The curves all show two distinct daily maxima and minima. The minima occur in all the months near 4 A.M. and 2 P.M. The times of the maxima are more variable, the day interval between the forenoon and the evening maximum being longer in summer than in winter.

The month showing the highest mean potential gradient is December, but the amplitude of the diurnal inequality is greatest in February. Whilst the amplitude of diurnal inequality, when considered absolutely, is greatest in the mid-winter months, the ratio in which it stands to the mean daily value is least at this season.

The diurnal inequalities for the several months are analysed in Fourier series, with 24-, 12-, 8-, and 6-hour terms. The 12-hour term is, in general, the most important, especially in summer; the changes in its amplitude and phase angle throughout the year are comparatively small. The 24-hour term is much more variable. It is much larger in the winter than in the summer months, and its phase angle varies greatly throughout the year.

The diurnal range, the 24 hourly differences from the mean for the day, and the amplitudes of the 24- and 12-hour waves, have their annual variation

expressed in Fourier series, with annual and semi-annual terms. In all cases the annual term proves to be the more important.

Attention is given not merely to the regular diurnal changes, based on mean results from a number of days, but also to the phenomena exhibited by the individual days themselves. It is found that the difference between the highest and lowest hourly values is, on the average, two and a-half times the amplitude of the regular diurnal inequality, and is, in fact, fully larger than the mean value for the day of the potential gradient.

The difference between the values of the potential gradient at successive midnights of the selected days, when taken irrespective of sign, averages about 43 per cent. of the mean daily value. When taken algebraically, there seems a slight tendency in the potential to rise during the selected days in December and January, but, taking the year as a whole, the mean non-cyclic element is exceedingly small.

The possible influence of various meteorological elements is considered from several standpoints. The influence of temperature is found to be much the most marked, there being a clear association of high mean potential and large diurnal range of potential with low temperature in every month of the year, except the hottest (July). In the winter months there is also an association of high potential with low wind velocity and high barometric pressure, but the association in these cases is much less clear.

Some of the data are compared with older data for Kew, obtained by Everett. In some respects there is fair agreement, but conspicuous differences exist. The results are also compared with other data given in a recent important memoir by Mr. A. B. Chauveau, for Kew and Greenwich, and for a number of stations in Italy and France, especially the Bureau Central Météorologique and the Eiffel Tower in Paris.

An Appendix makes a minute comparison of the diurnal inequalities of potential and of barometric pressure at Kew. A somewhat striking resemblance between the diurnal changes in these elements was pointed out by Everett in 1866, which possesses increased interest of late years, owing to Elster and Geitel's discovery that air extracted from the soil is usually markedly ionised, and their consequent suggestion that the variations of barometric pressure may influence the potential gradient by facilitating or retarding the escape of this ionised air into the atmosphere.

Everett's original comparison was between potential data from Kew and barometric data for Halle, both for the mean diurnal inequality from the whole year. Both elements are, in reality, considerably dependent on local conditions, and it thus seemed important to employ data for the same place. Mean diurnal inequalities were thus got out for each month of the year for

the barometric pressure at Kew, making use of the data published in the "Hourly Means" of the Meteorological Office for an 11-year period, 1890 to 1900. This enabled a really critical comparison to be carried out with the potential gradient. The result shows decisively that the similarity between the diurnal inequalities of the two elements is confined to the 12-hour terms; the 24-hour terms present, in fact, diametrically opposed phenomena in the two cases. The afternoon minimum and evening maximum of potential are in every month notably in advance of those of barometric pressure, and the 12-hour potential wave is about an hour in advance of that of barometric pressure throughout the whole year. Thus, if any relationship of cause and effect exists between the *regular* diurnal changes in the two elements, the pressure change would seem to be the effect, the potential change the cause.

Explosions of Coal-Gas and Air.

By Bertram Hopkinson, M.A., M.I.C.E., Professor of Mechanism and Applied Mechanics in the University of Cambridge.

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Explosions of Coal-Gas and Air.

The experiments here described consist in an investigation into the propagation of flame through a mixture of coal-gas and air contained in a closed vessel and ignited at one point by an electric spark. A continuous record is taken of the variation of resistance of fine platinum wires immersed in the gas, at different points; and at the same time and on the same revolving drum the pressure is recorded. The arrival of flame at any wire is marked by a sharp rise in its resistance. Thus the progress of the flame can be traced. Moreover, the rate of rise of temperature of the wire after the flame has reached it is (after certain corrections have been applied) a measure of the velocity with which the gases round about it combine. In this manner it has been possible to settle in the case of certain mixtures, at any rate, the question of "after-burning," which has long been a matter of controversy in the theory of the gas-engine, and to determine approximately the specific heat of the mixture of CO_2, H_2O, and inert gases which are the products of the combustion. Incidentally it has been necessary to find what relation the temperature of a fine platinum wire immersed in the